US Army Corps
of Engineers
Waterways Experiment
Station

Environmental Effects of Dredging

Vol D-97-1 February 1997

Beneficial use of dredged material is "in the bag"

by
Jessica S. Ruff and Charles R. Lee, U.S. Army Engineer Waterways Experiment Station
Wiener Cadet, U.S. Army Engineer District, Buffalo

Artificial or manufactured soil is not a new concept. Bagged "top soil," which can be purchased at most chain discount stores, is a manufactured product composed of silt and several additives.

The innovation is the application of this technology as a beneficial use of dredged material, and the exciting potential for commercialization that it represents.

Beneficial uses of dredged material are much in demand. The U.S. Army Corps of Engineers dredges more than 300 million cubic meters of sediment each year while maintaining the navigable waterways of the nation. However, many of the dredged material confined disposal facilities (CDFs) are full, and additional disposal areas are increasingly harder to find.

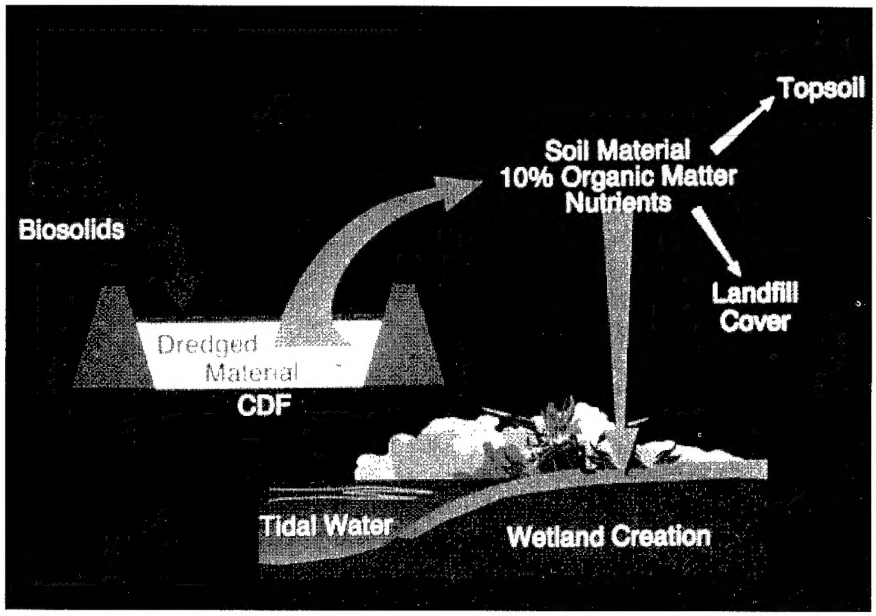
Likewise, sewage sludge can no longer be disposed in the ocean and is accumulating on land. To alleviate this situation, the U.S. Environmental Protection Agency (USEPA) issued regulations in 1994 that promote the use of biosolids derived from reconditioned sewage sludge.

Researchers at the Waterways Experiment Station (WES) are evaluating the potential of manufacturing artificial soil—a process that will address the excess of both dredged material and biosolids from sewage sludge. Dredged material serves as the silt ingredient, to which biosolids and organic waste materials are added.

Creation of golf courses is one use for manufactured soil

Expected benefits

The major goal of this research is to create new CDF storage volume by using the material in existing CDFs. This will provide additional disposal capacity for future dredged material.



Manufactured soil offers a variety of beneficial end-uses

An additional benefit for dredged material management is that manufactured soil requires finer grained material. In contrast, the more commonly used beneficial use disposals (beach nourishment, landfill, offshore berms) involve coarse-grained materials with high sand or gravel content.

It is also possible that manufactured soil technology may be applicable in situations where sediments are somewhat contaminated. The make-up of such a soil is evaluated in relation to the USEPA's Section 503 regulations, which outline the requirements for unrestricted use of reconditioned sewage sludge.

The relationship between the material's contaminant level and the appropriate beneficial or productive use of the material is determined based on the results of a risk assessment.

Manufactured soil can contain silt, sand, or basalt; recycled paper or yard waste; biosolids; calcium; charcoal; and ammonium nitrate or sulfate.

Cooperative research agreements

WES has established Cooperative Research and Development Agreements (CRDAs) with several companies to develop the technology for manufacturing soil using dredged material.

As a part of this effort, patented formulations will be evaluated to develop the technology for commercialization. The approach is to use dredged material as the silt or soil base of the mixture. Cellulose (in the form of yard waste, sawdust, vegetable waste, etc.) is added to supply organic material and nutrients. Organic-rich waste materials, such as reconditioned biosolids from sewage sludge or cow manure, are also added to supply slow-release organic nutrients. The right mixture will yield fertile soil of good tilth.

Researchers at WES, in cooperation with private developers, are developing screening tests to evaluate the productivity of different mixtures. Seed germination tests, using four annuals (tomatoes, marigolds, ryegrass, and vinca), help identify the most productive mixtures. These mixtures are those designated for use as landscaping topsoil for parks, roadsides, homes, and housing developments.

Extended growth tests are also conducted over a 7-week period. The results, which are based on both visual observation and biomass measurements, allow researchers to select the most promising soil mixtures for various uses.

Proposed demonstration sites

Several field projects to demonstrate the use of dredged material for manufactured soil are in the initial stages. Demonstrations are proposed or under way at several locations, including Lake Okeechobee, Florida; St. Lucie Estuary, Florida; Terrebonne Parish, Louisiana; and New York/New Jersey Harbor.

In addition, several Corps districts have requested assistance in evaluating their CDFs with regard to this potential use of dredged material.

Toledo Harbor demonstration

To better evaluate this technology, a field demonstration was conducted during September 1996 at Toledo Harbor, Ohio.

Responsibility for managing the long-term dredged material disposal needs of Toledo Harbor lies with the Corps' Buffalo District. After coordinating with the Study Team and Executive Committee of the Toledo Harbor Planning

Group, engineers at the Buffalo District decided to evaluate this technology as one alternative in the overall sediment management strategy for the Maumee River at Toledo.

WES was requested to develop the technology for manufacturing soil with dredged material from Cell 1 of the Toledo Harbor CDF. CRDAs have been established with several companies that are interested in using Toledo Harbor dredged material as an ingredient for manufactured soil products.

For example, one nationally known company has a requirement for over 4 million cubic meters of silt per year to produce its bagged soil product. Another company has a patent on the formulation of manufactured soil and equipment to produce the product onsite. Other commercial partners have expertise in producing reconditioned (pasteurized) biosolids from sewage sludge and cow manure and in developing formulations for wetland creation.

This project was originally proposed for designation as a USEPA "Environmental Technology Initiative." Funding did not materialize, however, and the Buffalo District provided funds to conduct the demonstration. The demonstration was a cooperative effort that involved the Corps of Engineers, the municipal government, commercial interests, academia, and volunteers.

The City of Toledo provided demonstration sites and trucks to transport manufactured soil to the sites. At the entrance to the University of Toledo (Figure 1) and at the Toledo Botanical Gardens, the use of manufactured soil for landscaping was successfully demonstrated.

Figure 1. Use of manufactured soil for landscaping proved successful at this demonstration site (entrance to University of Toledo)

Economics

Depending on the soil product that is used, estimates of the cost to produce manufactured soil using dredged material range from approximately $3.90 to $13.50 per cubic meter.

The economic incentive for use of the material is that the Corps or site owner can receive approximately $0.06 per cubic meter.

Preliminary results

Earlier studies have shown that dredged material from each source is different and will have its own best mixture for specific uses.

Using sediment originally obtained from the Toledo Harbor CDF, researchers have determined that the most productive manufactured soil mixture is 60 to 80 percent dredged material, 10 to 30 percent locally available sawdust/yard waste, and 10 percent reconditioned biosolids from sewage sludge. A mixture of 75 percent dredged material and 25 percent yard waste/biosolids was used for the field demonstration.

The dredged material from Toledo Harbor was also tested by a commercial bagged soil producer.

Screening tests performed by this company showed that the Toledo Harbor Cell 1 dredged material offers potential as an ingredient for a bagged soil product.

Through a CRDA, another company has developed a new biosolids product, with a pH of 7.0, that is specifically designed for mixing with the Toledo Harbor dredged material.

Seed germination was also evaluated by a commercial interest. The most productive mixture was 40 percent Toledo Harbor dredged material, 50 percent sawdust, and 10 percent biosolids (patented formulation).

During the 7-week growth experiment, visual observations of leaf color, size, and shape and measurements of total aboveground biomass were used to analyze the influence of different

manufactured soil mixtures on plant growth (Figure 2). Based on the initial results, WES researchers identified the best mixture for growth.

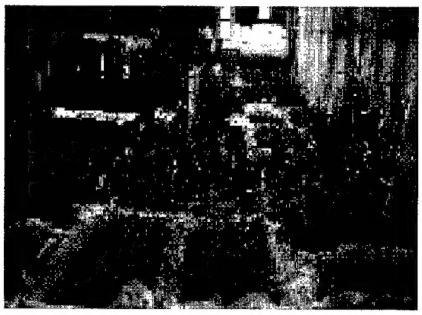


Figure 2. Plant screening tests help identify mixtures of manufactured soil that maximize plant growth

Future research

Uncontaminated and slightly contaminated dredged material has potential for use in manufacturing soil that can be used unrestrictedly as topsoil for landscaping, development of parks and golf courses, and as a bagged soil product.

The more contaminated dredged material can potentially be used to manufacture soil for application as covers in restoring or rehabilitating Superfund sites, mining sites, and landfills. The manufactured soil helps support vegetation, which in turn stabilizes the sites being restored.

Other demonstrations are planned to further evaluate the use of dredged material for manufactured soil and to explore the enormous potential this beneficial use offers.

For additional information, contact Dr. Charles R. (Dick) Lee, (601) 634-3585; e-mail leec@ex1.wes.army.mil.

Jessica S. Ruff *is the technology transfer specialist for the Environmental Effects of Dredging Programs and works for the Visual Production Center, Information Technology Laboratory, Waterways Experiment Station. She holds a Bachelor of Science degree in Journalism from the University of Southern Mississippi.*

Dr. Charles R. (Dick) Lee *is a soil scientist/agronomist in the Environmental Laboratory, Waterways Experiment Station. He leads the Contaminant Assessment and Monitoring Team and provides expertise in environmental chemistry and migration of contaminants in various wetland and upland environments. Dick holds a Bachelor of Science degree in chemistry from the University of Tampa, a Master of Science degree in soil chemistry from Clemson University, and a PhD in agronomy from Clemson University.*

Mr. Wiener Cadet *is a civil engineer in the Engineering and Planning Division of the Corps' Buffalo District. His areas of expertise are coastal engineering and water resource management engineering. He leads the technical team in developing a Long-Term Management Strategy (LTMS) for managing sediment in Maumee Bay at Toledo, Ohio. He also serves as liaison between the Executive Committee and the Study Team of the Toledo Harbor Planning Group. As team leader, he provides expertise in formulating and developing the LTMS for Toledo harbor. Wiener holds Baccalaureate degrees in the sciences of maths, physics, and chemistry, a Bachelor of Science degree in civil engineering from the University of Haiti, and a Master of Science degree in hydraulics and water resource engineering from the Polytechnic University of New York.*

US Army Corps of Engineers

Dredged Material Assessment and Management Seminar
April 29 (8:30 a.m.) - May 1, 1997 (5 p.m.)
The Savannah Marriot Riverfront
100 General McIntosh Boulevard
Savannah, Georgia

EPA

Who should attend: Any person involved in managing, testing, evaluating, or regulating dredged material. This includes dredging contractors, testing laboratories, port/marina authorities, resource agencies, and any person interested in the assessment and management of dredged material.

Presentations and discussions will include:

- Dredging Project Management-Environmental Compliance Responsibilities
- Regulations and Policies
- Dredged Material Disposal Alternatives Analysis
- Contaminant Testing and Controls
  - Capping
  - Manufactured soils
  - Remediation technologies
- Project Assessment and Sampling Design
- Tiered Testing for Determining Open Water Acceptability
  - Water column evaluations
  - Benthic evaluations
- Testing for Upland Disposal Areas
  - Effluent quality
  - Surface runoff quality evaluations
  - Leachate evaluations
  - Uptake evaluations for plants and animals
  - Volatile emissions
- Bioaccumulation Evaluations
- Chronic and Sublethal Evaluations and Interpretation
- Ecological Risk Assessments
- ADDAMS Models
- Quality Assurance/Quality Control
- R&D Programs and Implementation
- Current Events/Emerging Issues

Interested persons should contact Ms. Jeannie Roper at the Waterways Experiment Station, (601) 634-4148 (roperj@ ex1.wes.army.mil), as soon as possible, to reserve a space and receive a notebook of the presentations. Rooms are being held at the Savannah Marriot Riverfront, (912) 233-7722.

A registration fee of $65.00, made payable to the "Savannah Marriot," will be collected upon your registration at the meeting.

For additional information, contact one of the following: Ms. Jeannie Roper, (601) 634-4148, FAX (601) 634-4298; Dr. John Simmers, (601) 634-2803, or Mr. Tom Patin, (601) 634-3444.

Corps-EPA technical guidance now on-line

Project managers can now access two important dredging technical guidance documents through the Internet.

The homepage for the U.S. Environmental Protection Agency's Office of Wetlands, Oceans, and Watersheds (Ocean and Coastal Protection Division) provides information on several national environmental programs and links to EPA/Corps documents that are available on-line.

Two documents of special interest to dredging managers are the "Greenbook" ("Evaluation of Dredged Material Proposed for Ocean Disposal," EPA503-8-91/001, February 1991) and the "Technical Framework" ("Evaluating Environmental Effects of Dredged Material Management Alternatives," EPA842-B-92-008, November 1992).

The "Greenbook" can be accessed at URL **http://www.epa.gov/OWOW/oceans/gbook/index.html**, and the "Technical Framework" document at **http://www.epa.gov/OWOW/oceans/framework/index.html.**

These documents represent a joint effort between the Corps of Engineers and the U.S. Environmental Protection Agency to provide consistent national guidance for implementing the requirements of environmental legislation, including the National Environmental Policy Act, the Clean Water Act, and the Marine Protection, Research, and Sanctuaries Act.

EEDP

This issue describes the concept of using dredged material as an ingredient in manufactured soil products. This innovative process offers an alternative for beneficial use of both dredged material and biosolids from sewage sludge.

ENVIRONMENTAL EFFECTS OF DREDGING

This bulletin is published in accordance with AR 25-30 as an information dissemination function of the Environmental Laboratory of the Waterways Experiment Station. The publication is part of the technology transfer mission of the Dredging Operations Technical Support (DOTS) Program managed by the Environmental Effects of Dredging Programs. Results from ongoing research programs will be presented. Special emphasis will be placed on articles relating to application of research results or technology to specific project needs. Contributions of pertinent information are solicited from all sources and will be considered for publication. The contents of this bulletin are not to be used for advertising, publication, or promotional purposes. Citation of trade names does not constitute an official endorsement or the approval of the use of such commercial products. Communications are welcomed and should be addressed to the Environmental Laboratory, ATTN: Dr. Robert M. Engler, U.S. Army Engineer Waterways Experiment Station (CEWES-EP-D), 3909 Halls Ferry Road, Vicksburg, MS 39180-6199, or call AC 601/634-3624.

ROBERT W. WHALIN, PhD, PE
Director

DEPARTMENT OF THE ARMY
WATERWAYS EXPERIMENT STATION, CORPS OF ENGINEERS
3909 HALLS FERRY ROAD
VICKSBURG, MISSISSIPPI 39180-6199

OFFICIAL BUSINESS
CEWES-EV-I

BULK RATE
U.S. POSTAGE PAID
Vicksburg, MS
Permit No. 85